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Hybrid Solar-Wind Charging Station for Electric Vehicles and Its Simulation

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Abstract: ***In the world of electrical technology Electric vehicles play an essential role in energy saving and emission reduction of harmful greenhouse gases.*** *The electrical power industry is undertake rapid change. The rising of energy cost , the mass electrification of everyday life, and global warming are the major drivers that will be determine the speed at which such transformations will happen. Nevertheless of how quickly various utilities acceptance clever grid concepts, technologies, and systems, they all agree on the inevitability of this huge change. Charging station, as one of the most important feature of electric vehicle industry, must be able to accommodate the fast development of electric vehicles. In this activity, a hybrid solar-wind powered charging station is planned to deliver electricity for the electric vehicles.*

The new hybrid vehicle charging station brings with it completely different sources like PV systems, wind systems, the AC delivered, batteries area unit used as a main energy storage system, kind DC little grid for always energy carry out. This Paper explain relative accomplishment Hybrid Solar-Wind powered charging station using Buck and Zeta converter to balance the DC voltage. Proposed system analyze in MATLAB Simulink environment.

Keywords: Charging station, DC grid, Electric vehicle, PV system, Wind system, MATLAB Simulink

I. INTRODUCTION

A new Hybrid power charging Station machine is deliberate for the smart power delivery. The proposed hybrid power charging Station machine is connected with the 230V AC electricity provide, and it integrates with the renewable power reasserts of wind electricity and electrical phenomenon (PV) electricity, additionally to the electrical automotive. This paper can gift part dialogue of the machine configuration, machine manage is approach for smart power supply, and consequently the corresponding simulation of the overall performance.

Proposed hybrid power charging station machine is includes the following four subsystems, specifically the AC deliver module, the standby module, the renewable module, the garage module, the output load module. The AC deliver module presents the 230V AC electricity deliver for the 170V DC micro-grid. Through accepting the duplex AC/DC device, the DC micro-grid power can also be fed once more to the AC electricity aspect. Furthermore, the proposed DC grid machine will accept the battery. Hence, the proposed DC micro-grid machine cannot best supply for the excessive exceptional electricity for three modes of DC and AC masses. However, to boot acquire several distinctive functions and traits for smart power supply.

The output load module consists of the three modes of masses, particularly the 110V single-section AC load, 48V DC load, and consequently the 100V DC load, which could additionally to the boot cowl most common place appliances. Moreover, the orally communication module connects all of the inverters, converters, and corresponding electricity alerts through the computers. The renewable module accommodates the wind electricity and Photovoltaic (PV) electricity provide, which could be reworked to the DC 170V through the DC/DC and AC/DC device. For the Photovoltaic (PV) electricity branch, the most of the issue chase maximum power point tracking (MPPT) manage is employed to draw in the maximum sun power through calibration the duty cycle of the DC/DC device. For the wind electricity branch, a current magnificence of permanent magnet (PM) brushless gismo is also usual seize the alternative energy for the micro-grid machine.

Therefore, the proposed DC small grid machine are capable of to do the smart and versatile cap potential to perform for the smart power supply. One amongst the disputes in the DC electricity structures is to generate bound the electricity within the machine hold balanced forever for dependable and economical operation. It will end up to be advanced special in conditions whereby the machine accepts affected by essential disturbances evolving from one of a kind sections within the machine. Moreover to introducing safety schemes in Hybrid Charging Stations for Electric Vehicles, it's miles essential to recollect coordinated and optimized operation to manage machine.

However, it's currently not been exceptionally investigated in most of the conservation plan. During this paper, a coordinated improvement and manage theme is planned for totally on random load profile also to on the spot machine disturbance info. The aim is to provide coordination among the machine safety on the controller stage and the stronger stage improvement to generate bound, the machine hold optimized in any respect factors of operation despite the disturbances. So as to place into impact and validate the proposed approach, the DC-primarily based completely deliver board electricity machine (SPS) is taken into account. The electrical distribution machine on board, delivery got to be capable of supply elementary options which incorporates electricity generation, distribution, manage, electricity conversion, power garage and utilization. Typical SPSs are self-contained and assign radial distribution architectures.

Therefore, zonal distribution structures have obtain appealing because it could supply higher reconfiguration capabilities. Newly improvement of SPSs is trending nearer to the thought of incorporated electricity machine (IPS), that's appeared as a large-scale, on-board small grid incorporating smart way for assembly loading wishes with dynamically matching people capability. However, the DC primarily based completely IPS has been investigated to update the normal AC SPS because it could convey overall higher operational performance and management capabilities.

II. METHODOLOGY

Exiting device with star completely charging stations to be had for electrical vehicles. Analysis is presently current. Once coming up with the sun energy station various different factors area unit taken into consideration: created neck of the woods, the annual sun insolation, tilt perspective of the modules, wide range of the sun modules, the close temperature, shading, the seasoner cooling of the modules. The wide range of the sun modules directly adjudge the performance of the sun energy station. A large wide range of modules can explosion their operating space [14].

The DC energy link congenitally has not the harmonic issue, the DC micro-grid will achieve a higher great energy than the standard AC grid device. The DC micro-grid fully eliminates the electrical device, as a result enhancing the energy transmission performance and economy the grid itself. The 230V AC energy deliver could also be became off if the grid meets the load wants in any such manner that the grid will feed itself and store the strength from outside.

Also, if the grid has further strength than the wants, the energy could also be to boot fed to the 230V AC aspect via approach of suggests that of the AC/DC device. During this manner, the grid might even promote the energy and earn the cash. The standby strength module usually doesn't provide the energy to the grid, due to this that that the grid achieves the fault-tolerant ability. What is more, the diesel technology device directly provides the 170V DC energy to the grid, as a result no requiring any device. Sun energy station have different factors area unit taken into application: constructed neck of the woods, annual sun insolation, tilt perspective of modules, wide range of sun modules, close temperature, shading, seasoner cooling of modules.

Star modules convert sun radiation directly into power via an electrical phenomenon collision. This can be a silent and swish method that does not necessity motion of components. The physical occurrence influence may be a semiconductor influence whereby sun radiation getting access to the semiconductor photocells generates the motion of electrons. Electrical phenomenon cells convert sun strength into DC. The number of sun radiation falling at the world will currently not rely upon act, even though this parameter is taken into thought while preferring the neck of the woods of the energy plant, handiest sun entirely totally charging station not satisfy all demand therefore layout hybrid charging station for electrical power-driven Vehicles.

The characteristic functions and traits of the projected DC micro-grid for charging of the electric vehicle device could also be summarized as follow: The DC micro-grid impulsive gain the excessive unbiased operation ability. Even while the AC energy will not supply, the DC grid will nevertheless act healthy. It way, if a twist of fate takes place within side the AC energy supply, this grid will fusion and distribute the energy in step. It will showing cleanliness offers for electric vehicle charging. By integrating of the renewable strength module, the garage strength module, standby strength module, and the AC deliver module along with the projected micro-grid device will do smart and merge strength transport for the load sides. It approach that the grid will distributed the energy via approach of suggested optimizing renewable strength, the AC energy supply, and the garage strength module.

III.CONTROL TECHNIQUE

A. Pulse Width Modulation Technique (PWM)

PWM is a modulation technique that creates variable width pulses to represent the amplitude of an analog input signal. The output switching transistor is ON maximum of the time for a high-amplitude signal and OFF maximum of the time for a low-amplitude signal. The digital nature (fully ON or OFF) of the pulse width modulation (PWM) circuit is less costly to fabricate. PWM is widely used in ROV applications to control the speed of a DC motor and the brightness of a light bulb.

The pulses are to be given to the IGBTs are generated with a fundamental waveform compared with a triangular waveform. A full bridge inverter with s IGBTs can be used to convert DC to three phase AC.

The frequency of the grid and the three-sided or carrier waveform has higher frequency to create a alternation signal. The generated pulses are fed to the Voltage source Inverter is shown in fig. Due to the impedance load, the load current gets desists during sudden switch OFF of the IGBT switch and create high voltage peaks in the output voltage. To avoid an anti-parallel diode is attached to the switch (IGBT) so that the inductor current from the impedance load can pass through the diode.

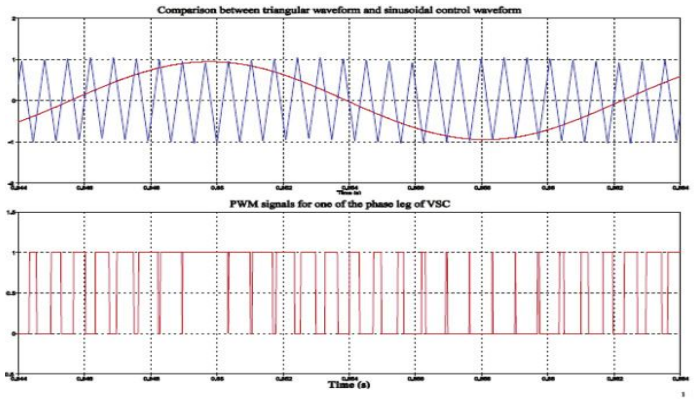

Fig. 1: Generation of pulses with respect to reference fundamental waveforms

B. Maximum-Power-Point-Tracking Algorithm

MPPT algorithms are essential in PV applications because the MPP of a solar panel varies with the irradiation and temperature, so the use of MPPT algorithms is essential in order to gain the maximum power from a solar array.

Among all the algorithms P& O and Inc Con algorithms are most familiar as they have the advantage of an freely implementation. In natural conditions the P-V curve has only one maximum point.

MPPT scheme to track most extreme power amongst any light and air conditions. The outline of PVA is done in MATLAB with Simulink cramp, with numerical representation. The DC-DC converter exploit as a part of the MPPT can be either a Cuk converter or a Buck Boost converter.

The voltage yield of the PVA either must be extended or decreased as for the yield power of the PVA. The converter build the voltage stable with the modification in the temperature or the light.

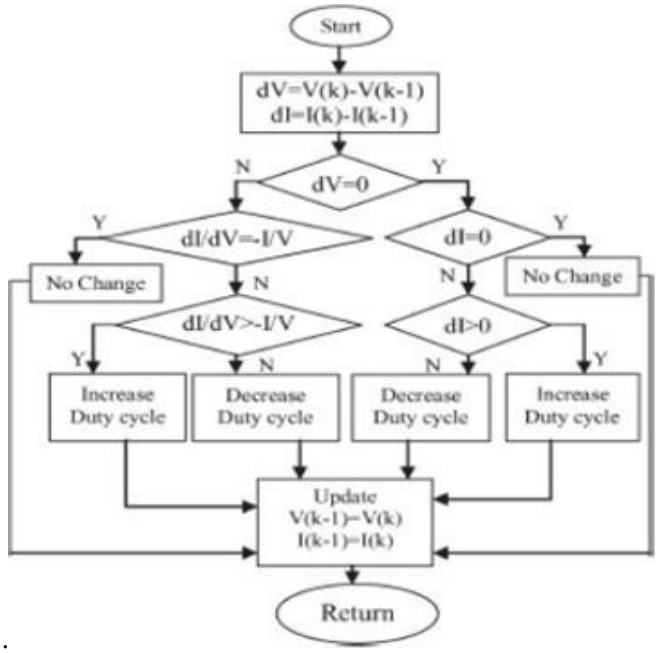

Fig. 2: MPPT Algorithm

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C. Photo-Voltaic Array (PVA) Modeling

For productive indefatigable power age PVA (Photo voltaic array) is apply to generate power from sunlight-based light. As the load demand is increasing day by day and the generation of electrical energy also has to be increased, but due to the conventional way of power generation is causing global warming. Due to this, the productivity of the PVA has to be increased by adding silicon surface. And also operate MPPT techniques to trace maximum power during any irradiation and atmospheric conditions. For efficient renewable power generation PVA is used to power generation from solar irradiation.

The design of PVA is done in MATLAB with Simulink block, with mathematical portrayal. The Boltzmann constant and the reference cell operating temperature have to be in the same units i.e., either Celsius or Kelvin. The mathematical design of the above formulation can be constructed using Simulink blocks is as below in fig. 3.

The above modelling is for a single cell voltage, in order to increase the voltage of PVA, cell voltage has to be multiplied to a convenient value considering each cell voltage as 0.4 V. So, the no. of series connected cells (Ns) can be determined as:

$$N_s = \frac{V_0}{0.4}$$

To get each cell current, the total current output from the reliable source has to be divided by number of parallel connected cells (Np). Therefore, parallel connected cells are considered as –

$$N_p = \frac{I_o}{I_{cell}}$$

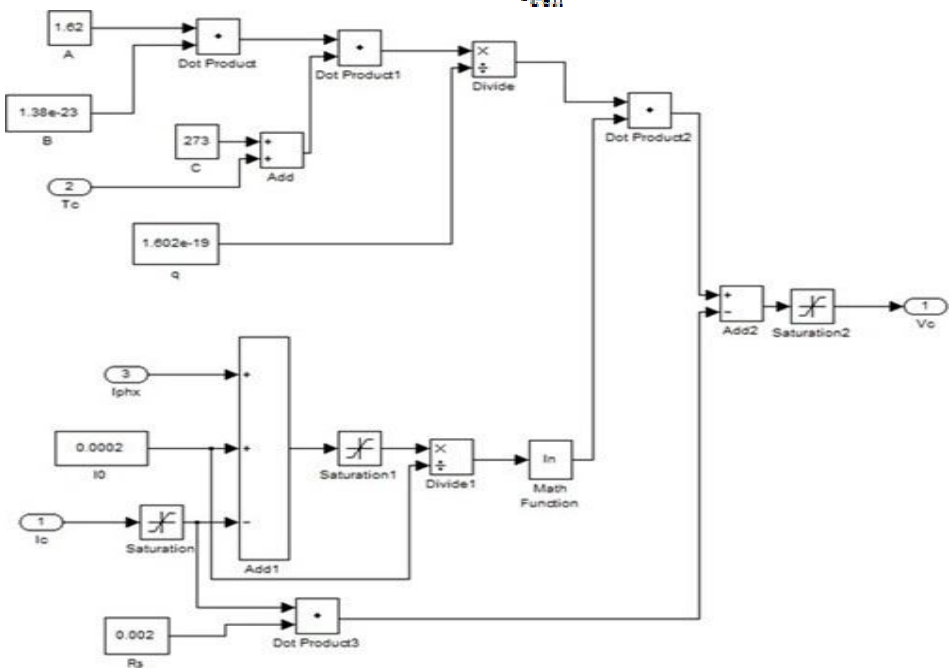

Fig. 3: Simulink model of Vc

The representation in Simulink is taken as-

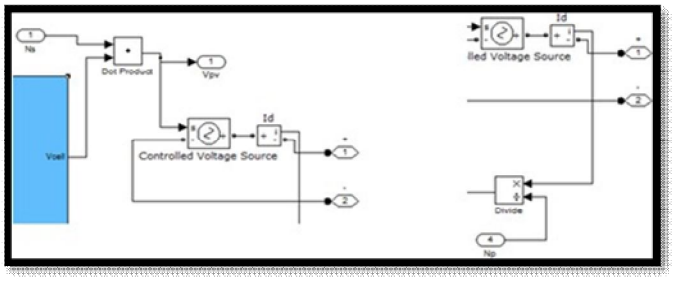

Fig. 4: Simulink modeling of Ns & Np

For the calculation of Vcx (cell voltage) and Iphx (Photocurrent) we require correction factors C_{TV}, C_{TI}, C_{SV}, C_{SI}. The Equation is given as –

$$V_{CX} = C_{TV} C_{SV} V_C$$

$$I_{phx} = C_{TI} C_{SI} I_{ph}$$

The correction factors are given as -

$$C_{TV} = 1 + \beta_T (T_a - T_x)$$

$$C_{TI} = 1 + \frac{\gamma_T}{S_c} (T_x - T_a)$$

$$C_{SV} = 1 + \beta_{Tas} (S_x - S_c)$$

$$C_{SI} = 1 + \frac{1}{S_c} (S_x - S_c)$$

Where,
βT = 0.004 and γT = 0.06
Ta = reference temperature
Tx = ambient temperature
Sc = reference solar irradiation
Sx = ambient solar irradiation.

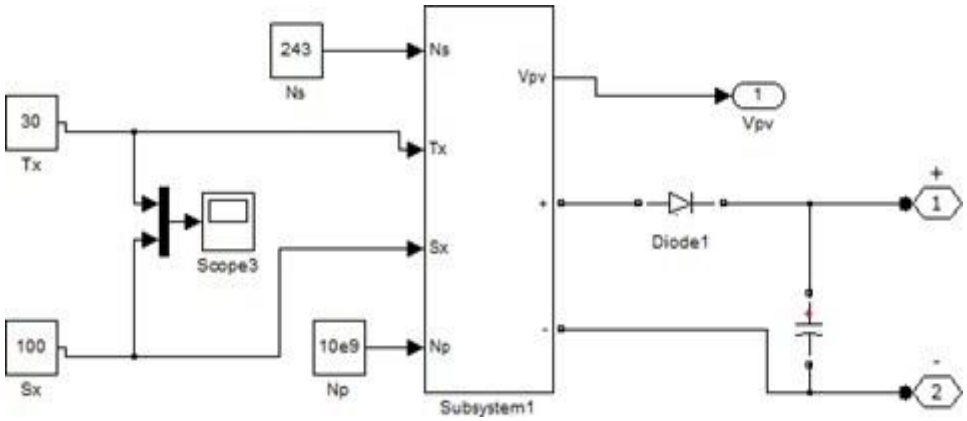

Fig. 5: Complete diagram of PVA

D. Permanent Magnetic Synchronous Generator (PMSG) Wind Systems

There are many kinds of unpredictable speed generators used for wind turbine. In spite of the fact that doubly fed induction generator (DFIG) is more mainly used than permanent magnetic synchronous generator (PMSG) today, PMSG has some advantages which are tally as experts.

Principally, PMSG is direct drive, has slow rotation speed, does not have rotor current, and can be used without gearbox. The high efficiency and low maintenance will reduce the cost that is the most anxiety to invest. However, PMSG still has some drawbacks. It requires electromagnetic field with the flexible structure, which leads to the high standard of the manufacture as well as of the performance.

Additionally, variable speed of the generator has to be familiar by power inverter too. Wind energy system are considered as the most beneficent energy systems in renewable power source power age classification. The model system and control scheme contain a PMSG wind turbine model, a pitch angle control model, generator-side inverter control model, and grid-side inverter control model.

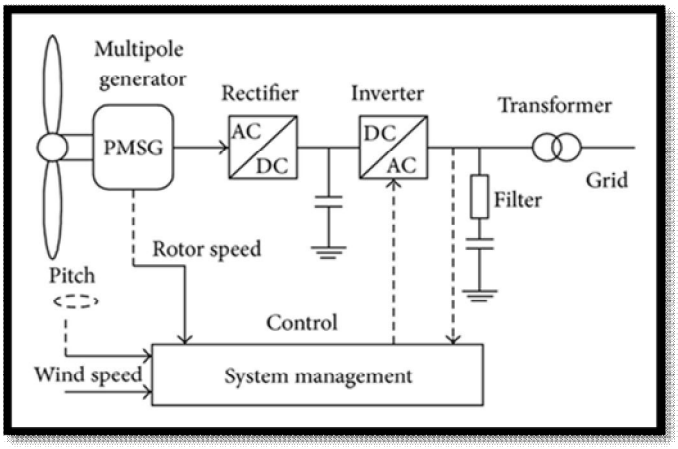

Fig. 6 : General wind turbine PMSG system

IV. RESULTS

In the figure there are three loads connected in which the first load is an AC load with inverter and other two loads are low voltage DC loads. The low voltages (100V and 48V) are generated by using the conventional buck converters.

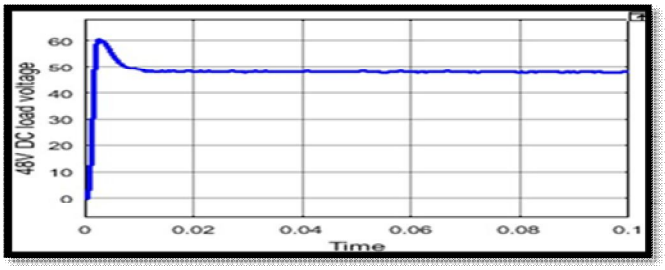

Fig. 7 : 48V DC load voltage measured after buck converter

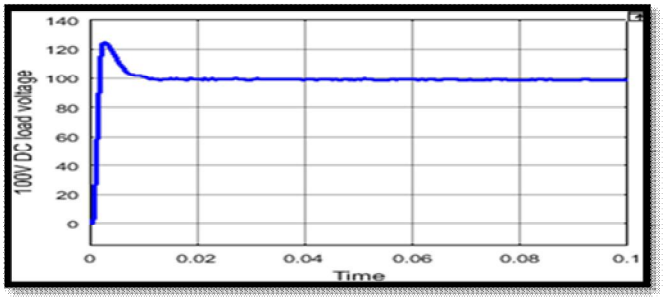

Fig. 8 : 100V DC load voltage measured after buck converter

The testimonial DC link voltage is set to 170V which is the peak value of 110Vrms AC load connected to the DC link.

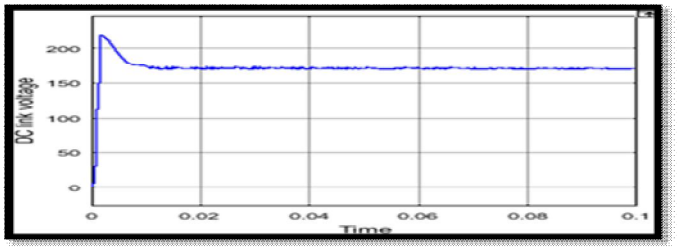

Fig. 9 : DC link voltage

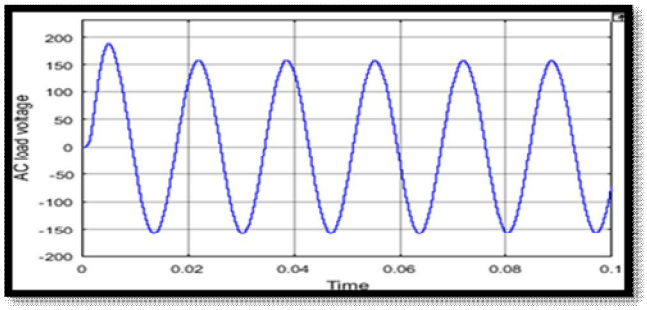

Fig. 6 : Inverter Output Voltage for AC Load

V. CONCLUSIONS

The PV system and battery technologies are also essential to increase the implementation of this type of system. For next studies, new systems will allow the energy flow between the EV (Electric vehicles). Therefore it will minimizing the dimensions of the charging stations may be considered as an option. In order to manage and minimize the negative effects of this new load potential on the grid, usage of the local energy resources is inevitable. The EV (Electric vehicles) should be able to benefit from these sources effectively. In this study, a hybrid fast-charging system that is distributed by local renewable energy resources rather than the grid is scrutinized. The scrutiny is conducted with real weather station data.

In this paper, we have introduced a new hybrid renewable charging mechanism for EVs. A simulation model has been developed using MATLAB-Simulink and the performance of solar and wind energy has been studied. Various parameters of the solar module have been verified under different irradiation level. The Synchronous Generator has been studied under different loading condition. Finally, the hourly load of EV versus generated electricity has been analyzed. From the output generated by the hybrid system, we strongly say that the proposed SWCM provides enough power for recharging the electric vehicle and the time taken for charging can be avoided by battery swapping method. At last, we conclude that this system proceed towards minimize the pollution. It will also increase the usage of EV (Electric vehicles) as it will create pollution free environment.

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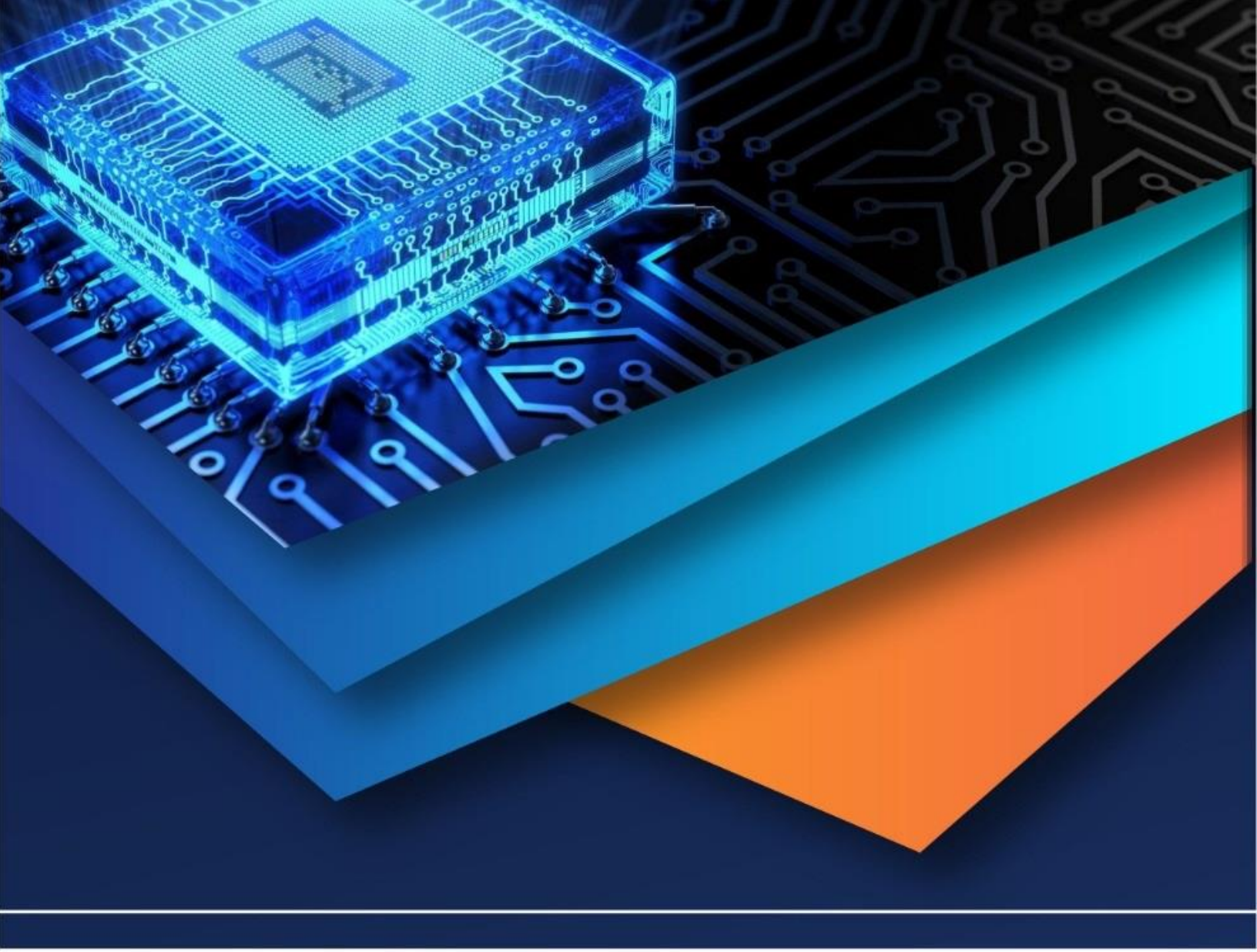

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